CURRENT LITERATURE

MINOR NOTICES

Nathanson's textbook of botany.—This book[1] is written from a strictly physiological standpoint, structures receiving scant attention except as they are related to functions. The subject-matter is divided into two parts, the vegetative life and the reproduction. The first part is subdivided into (1) nutrition as a fundamental function of vegetative life, (2) the vegetative organs of the algae, (3) the structural plan of the organs of the higher plants, (4) the life history of the vegetative organs of the higher plants, (5) the orientation of the vegetative organs in space, and (6) the structure of the vegetative organs under special conditions of nutrition. The second part is subdivided into (1) reproduction in the lower plants, (2) mosses and cryptogams, (3) reproduction in flowering plants, (4) the relation between the vegetative life and reproduction, and (5) heredity. The book closes with a few remarks on the principal groups of plants.

This presentation could be read, with profit, by all classes of botanists, particularly by morphologists, who stand in greater need of such a presentation. Morphologists, however, can hardly regard the text as a "general botany," since it gives so little attention to development and phylogeny.—CHARLES J. CHAMBERLAIN.

Natal plants.[2]—The recent appearance of part 4 completes the sixth volume of this well known work. The present part contains descriptions and full-page illustrations of 25 species, most of which are of comparatively recent publication, hence little known. A brief chapter is added giving notes and corrections on plants mentioned in volumes I–VI inclusive. One species, *Brachystelma Franksiae* N. E. Brown, is new to science.—J. M. GREENMAN.

NOTES FOR STUDENTS

Physiology of lichens.—The greatest advantage to the lichen of parasitism with the alga was formerly supposed to be that the lichen received carbon which the alga obtained from the air. But now it appears reasonable to suppose that the lichen may furnish the alga a portion of the carbohydrates which it secures from the substratum. This of course cannot occur when the lichen

[1] NATHANSON, A., Allgemeine Botanik. 8vo. pp. viii+471. *figs. 394.* Leipzig: Quelle und Meyer. 1912. *M* 10.

[2] WOOD, J. MEDLEY, Natal Plants. Vol. **6,** p. 4, *pls. 576–600.* Bennett & Davis. Durban, 1912.

grows on rocks that contain no organic matter. Breathing pores have been postulated for the lichens in a general way, but we really know little about provision for exchange of gases in these plants. The student will find a general summary by FÜNFSTÜCK in ENGLER and PRANTL'S *Natürlichen Pflanzenfamilien*. In 1906 ZOFP[3] described a new *Ramalina* (*R. kullensis*) which has the so-called breathing pores well developed, and ROSENDAHL[4] in 1907 found them in *Parmelia aspidota*. Nothing more seems to have been added to FÜNFSTÜCK'S statement, and it appears probable that passages from the exterior to the interior of lichen thalli are rare instead of common.

TOBLER[5] thinks that such passages may be expected in thalli with thick cortices, but scarcely in those with thin cortices, where sufficient aeration may occur without them. He believes that the lack of sufficient air and light within the lichen thallus makes the conditions unfavorable for the alga and that this accounts for the layering of the algae near the surface of the thallus. TOBLER cultivated *Xanthoria parietina* and a number of other lichens without algae in a gelatin-beerwort medium and got a rich production of calcium oxalate. He then cultivated the thalli with the algae and was not able to find the oxalate. He supposes, therefore, that the algae used the surplus extracted from the medium by the lichen, and that the same occurs in nature, the lichen taking the oxalate from the organic substratum. We may add that according to ELENKIN'S[6] theory of endosaprophytism, the lichen may extract organic compounds from the dead algae for the living.

TREBOUX[7] is cited by TOBLER to the effect that species of *Chlorella*, *Pleurococcus*, *Cystococcus*, and some other algae investigated, are able to obtain carbon in a very different manner from that known in higher green plants. It was found that these algae are able to thrive on artificial media containing organic acids, and the conclusion was reached that they behave much like fungi with respect to carbon assimilation.

TOBLER failed to notice the excellent work of ARTARI,[8] performed on algae which grow in lichen thalli, to ascertain the physiological relationship of the

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[3] ZOFP, W., Biologische und morphologische Beobachtungen über Flechten. II. Ber. Deutsch. Bot. Gesells. **24**:574–580. *pl. 23*. 1906.

[4] ROSENDAHL, F., Vergleichende anatomische Untersuchungen über die braunen Parmelien. Nov. Act. Kais. Leop. Karol. Akad. **87**:404–459. *pls. 25–28*. 1907.

[5] TOBLER, F., Zur Ernährungsphysiologie der Flechten. Ber. Deutsch. Bot. Gesells. **29**:3–12. 1911.

[6] ELENKIN, A., Zur Frage der Theorie des Endosaprophytmus bei Flechten. Bull. Soc. Imp. Nat. Moscou II. **18**:164–186. 1904.

[7] TREBOUX, O., Organische Säuren als Kohlenstoffquelle bei Algen. Ber. Deutsch. Bot. Gesells. **23**:432. 1905.

[8] ARTARI, A., Über die Entwickelung der grünen Algen unter Ausschluss der Bedingungen der Kohlensäure Assimilation. Bull. Soc. Imp. Nat. Moscou II. **23**:39–47. *figs. 2*. 1899.

algae to the lichens. ARTARI grew *Cystococcus humicola*, obtained from the thalli of *Xanthoria parietina* and *Gasparrinia murorum*, in pure cultures on complicated media containing mineral salts or organic compounds, or in some instances both the salts and the organic matter. He found that the algae grew luxuriantly on the media containing organic matter and were dark green in color when grown in absolute darkness or in light with CO_2 excluded. On media containing mineral salts but no organic matter, the algae grew under similar conditions, but not so well. These results square beautifully with those of TOBLER, the one worker giving special attention to the lichen, and the other to the alga which lives in the thallus of the same lichen. The two researches show conclusively that the alga which lives in the thallus of *Xanthoria parietina* can obtain its organic matter as well as the mineral salts from the lichen, provided the latter grows on some other substratum than rocks that contain no organic matter.

BEYERINCK, BOUILHAC, ETARD, KLEBS, and others have obtained results with algae somewhat similar to those of TREBOUX and ARTARI, two of the authors working on a blue-green alga (*Nostoc*). *Trentepohlia umbrina* grows in the bark of trees, sometimes with lichen thalli and sometimes alone. In fact this alga bores into the bark of trees or effects an entrance through minute openings in the periderm, probably either because abundant light is not favorable to its best development, or because closer relationship with the organic matter of the periderm is more essential to its development than bright light. This alga would be an especially favorable object for such investigations as those noted above.

TOBLER also started cultures of *Xanthoria* on gelatin and transferred them to a liquid medium which contained none of the carbon compounds needed by the alga except what was in the air, and the lichen grew somewhat. The alga grew in the same liquid medium and was of normal appearance. In transferring the lichen, particles of the gelatin were unavoidably carried over. After these were probably consumed by the lichen, the alga was introduced into the culture with the lichen and grew well, but was colorless. This, he thinks, indicates that the lichen had assimilated the acid which the alga needed as a source of carbon, probably oxalic acid. He says that gelatin is not a source of carbon for the alga, so that his conclusions would not be invalidated even if the lichen had not extracted all of the gelatin from the medium before the alga was introduced.

The lichen hyphae soon entwine some of the algal cells in the culture, and thus the parasitic, or at least a symbiotic, relationship is established. TOBLER believes that the lichen obtains carbon from the alga, while the latter replaces it by extracting carbon from the oxalic acid contained in the tissues of the lichen. This means a mutual exchange of food materials between the lichen and the alga, at least as a probability. His investigation seems to indicate that the alga growing in *Xanthoria parietina* and those found in several other lichens very probably obtain their carbon from the lichen, the latter in turn

obtaining it from the organic material in the substratum. This is probably true except for lichens that grow in substrata containing no organic material and perhaps for those having thin cortices. ROSENDAHL found that thinness of cortex and presence of calcium oxalate go together in the species of *Parmelia* studied. This would indicate that the algae in lichens with thin cortices obtain their carbon from the air, and so the oxalate is stored in the lichen, while in the lichens with thick cortices the alga secures little or no carbon from the air and utilizes the oxalate obtained from the substratum by the lichen.

These investigations of TOBLER, ARTARI, and others prove that we know little regarding the nutrition of lichens and their algal hosts. The results already obtained are important and suggestive. It is to be hoped that much more work of this kind may be done.—BRUCE FINK.

Metabolism of fats.—IVANOW has published a series of papers on the metabolism of fats in higher plants. He emphasizes how little our knowledge has advanced in this field since the classical work of SACHS, and contrasts it with the advances made in our knowledge of protein metabolism in plants. IVANOW[9] believes he has established that the synthesis of fats from glycerin and fatty acids comes about through the reversible action of lipase, a view apparently well established in animal metabolism.

Another paper[10] deals with the transformation of fats during germination. In order to have seeds with the greatest possible variation in the nature of the fats as regards the saturation of the fatty acids involved, he used flax (very rich in fatty acids of the linoleic type: $C_nH_{2n-6}O_2$), hemp (rich in the linoleic type: $C_nH_{2n-4}O_2$), rape (rich in the oleic type: $C_nH_{2n-2}O_2$), and poppy (rich in the palmitic type: $C_nH_{2n}O_2$). In the developing seedling he finds that the intensity of consumption of the fatty acids originating from the fats is inversely proportional to the degree of saturation. The linoleic type of acid disappears first, and with it of course the hexabromide test; then follows the linoleic, oleic, and finally the palmitic types. The fall in the iodine number of the fat during germination is due to the more rapid transformation of the more unsaturated acids to carbohydrates, and not to their saturation by oxidation leading to the formation of acids with shorter chains. The acid number of the fat from each plant is a strictly determined matter, low when the fats are rich in unsaturated acids, and high when rich in saturated acids. If the constituent parts of the oil in a plant are known, one can approximate closely the acid number of that oil. The unsaturated fatty acids are largely tied up in the glyceride, while the saturated acids exist to a larger degree in the free state. The transformation of the oils during germination is by

[9] IVANOW, SERGIUS, Über Oelsynthese unter Vermittlung der pflanzlichen Lipase. Ber. Deutsch. Bot. Gesells. **29**: 595–602. *fig. 1.* 1911.

[10] ———, Über die Verwandlung des Oels in der Pflanze. Jahrb. Wiss. Bot. **50**: 375–386. 1912.